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## OBSERVATIONS ON THE NUTATION OF SUNFLOWERS.

BY W. A. KELLERMAN, PH.D., AGR. COLLEGE, MANHATTAN, KAS.

It is a common and apparently almost universal belief, that the sunflowers turn with the sun; that is to say, that the disk is turned in the morning toward the east, and that it slowly moves southward until noon, and then westward till night, keeping pace with the apparent motion of the sun. This belief in case of most people rests, so far as I can determine by inquiry, not so much on direct observation as on hints and assertions of others. It is, in fact, mainly traditional.

That there is some movement, has undoubtedly been observed by very many, but how general and extensive in scope it is, is less accurately known. To determine this point for my own satisfaction, I undertook the past season to make a careful record of observations on the commonest of our native sunflowers, namely, *Helianthus annuus*, which is considered to be identical with the commonly-cultivated species. These observations are recorded in tabular form below.

The record, commenced September 2, was interrupted September 4, 5, and 6. It was resumed September 7, and continued until September 17.

The observations were made usually between seven and eight o'clock in the morning, and between five and six in the evening. When the wind was very strong, so as to interfere with the normal position of the heads, no observations were recorded. Following the tabulation will be found a record of the daily direction of the wind.

The plants observed, forty in number, were for the most part in a small, nearly level pasture field. A few of them were near trees, but the position of each plant is stated in the tabulation below. Some of them had but a single head, the majority had several, and one plant had thirty-five heads. They were of various heights, ranging from sixteen inches to eleven feet.

No compass was used in determining directions, but as the fences around the field were exactly east and west and north and south, it is not presumed that many grave errors were made. The directions noted were north, south, east, west, northeast, southeast, northwest, southwest, north-northeast, east-northeast, east-southeast, south-southeast, north-northwest, west-northwest, south-southwest, west-southwest, and all of the points between those already named (as north by east, north by northeast, etc.), making thirty-two in all, or twelve and one-half degrees between each. It is then plain that the slightest movement detectable without an instrument could be recorded.

Before proceeding to an analysis of the table, it might be stated that observations were made Sept. 9, on *Helianthus rigidus*. About 110 heads of exposed plants occupying a very small area by the roadside were counted at 9 a.m. It was found that nearly all of them were turned southeast upward; a few were directed eastward, and a few southward. At 6 p.m. they were again carefully observed, when it was found that most of the heads had turned slightly more southward.

A similar count was made of blooming heads of *Helianthus annuus* near the preceding cluster on the same day (Sept. 9). Four hundred and twenty heads were counted in the morning, and five hundred in the evening. No note was taken of directions between the cardinal points of the compass; those heads were therefore omitted that were exactly between these points, but all others were included. The result of these two counts is as follows:

	MORNING.		EVENING.																		
Heads turned toward the	<table border="0"> <tr> <td>East.....</td> <td>158, or 37.62%</td> <td>Heads turned toward the</td> <td style="text-align: center;"> <table border="0"> <tr> <td>East.....</td> <td>179, or 35.80%</td> </tr> </table> </td> </tr> <tr> <td>South.....</td> <td>133, or 31.66%</td> <td>South.....</td> <td>168, or 33.60%</td> </tr> <tr> <td>West.....</td> <td>58, or 13.80%</td> <td>West.....</td> <td>104, or 20.80%</td> </tr> <tr> <td>North....</td> <td>71, or 16.90%</td> <td>North....</td> <td>54, or 10.80%</td> </tr> </table>	East.....	158, or 37.62%	Heads turned toward the	<table border="0"> <tr> <td>East.....</td> <td>179, or 35.80%</td> </tr> </table>	East.....	179, or 35.80%	South.....	133, or 31.66%	South.....	168, or 33.60%	West.....	58, or 13.80%	West.....	104, or 20.80%	North....	71, or 16.90%	North....	54, or 10.80%		
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West.....	58, or 13.80%	West.....	104, or 20.80%																		
North....	71, or 16.90%	North....	54, or 10.80%																		

The indication from the above is that during the day but two to seven per cent of the heads turn from any given point through 90°. But there may be movements through an arc of much smaller dimensions, and these are, of course, not here indicated. Such movements are, however, shown in the tabulation below.

It can be seen, upon cursory examination of the tables below, that, as a rule, the heads while in bloom, move from morning to night, and from night to morning, through only a very small space—that but few move through a space approaching a half-circle, and in many cases there is no perceptible movement at all.

#### SUMMARY OF THE TABLE OF OBSERVATIONS.

Total number of heads observed.....	328
Total number cases of observations recorded.....	1,840
Total number cases of movements of heads.....	1,214, or 66%
Total number cases of no movement.....	626, or 44%

#### SUMMARY OF THE 1,840 CASES RECORDED.

DAY.	NIGHT.
Movements West..... 436, or 23.70%	Movements East..... 401, or 21.79%
Movements East..... 152, or 8.26%	Movements West..... 158, or 8.58%
Movements up..... 15, or 0.82%	Movements up..... 14, or 0.76%
Movements N. to S..... 11, or 0.60%	Movements N. to S..... 9, or 0.49%
Movements S. to N..... 9, or 0.49%	Movements S. to N..... 9, or 0.49%
No movements..... 243, or 13.20%	No movements..... 383, or 20.81%

#### SUMMARY OF THE 1,214 HEADS THAT MOVED.

DAY.	NIGHT.
Movements West..... 436, or 69.98%	Movements East..... 401, or 67.88%
Movements East..... 152, or 24.40%	Movements West..... 158, or 26.74%
Movements up..... 15, or 2.41%	Movements up..... 14, or 2.38%
Movements N. to S..... 11, or 1.77%	Movements N. to S..... 9, or 1.51%
Movements S. to N..... 9, or 1.44%	Movements S. to N..... 9, or 1.51%

It might be added, finally, that the heads were rarely observed (in reference to nutation) unless at least a few of the florets were in anthesis, and the observations were continued in most cases until the last of the florets were in full bloom.

It is likely that nutation is more marked in the head previous to anthesis, but this question was not regarded.

The tabulation needs no explanation, except to say that the uppermost head is given in the first column, after the date and time of day, that the outermost head of successive branches passing downward are numbered in serial order, and that second or third heads, etc., on the branches, are indicated by added numerals in smaller type.

No. 1.—Thirty-three inches high; poplar trees two-thirds of a rod east; maple grove two rods south; plant isolated.

September.	Time.	Upper.	2	3	4
2.....	A M.....	S.....	.....	.....	.....
2.....	M.....	N.....	.....	.....	.....
2.....	P M.....	N by NW.....	.....	.....	.....
3.....	A M.....	N.....	NW.....	.....	.....
3.....	P M.....	N.....	N.....	.....	.....
7.....	A M.....	N.....	NNE.....	NNW.....	WNW.....
7.....	P M.....	N.....	NNE.....	NNW.....	W by NW.....
8.....	A M.....	N.....	NNE.....	N by NW.....	up S.....
8.....	P M.....	.....	NNE.....	NW.....	WNW.....
9.....	A M.....	.....	NNE.....	NNW.....	NW.....
9.....	P M.....	.....	NNE.....	NNW.....	NW.....
10.....	A M.....	.....	Destroyed.....	Destroyed.....	Destroyed.....

No. 2.—Four and one-half feet high; in pasture field, isolated.

Sept.	Time.	Upper.	2	4	4 <sup>2</sup>	5	8	8 <sup>2</sup>	10	10 <sup>2</sup>	5 <sup>2</sup>
2.....	A M.....	NW.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2.....	M.....	NE.....	NE.....	.....	.....	.....	.....	.....	.....	.....	.....
2.....	P M.....	S.....	up N.....	.....	.....	.....	.....	.....	.....	.....	.....
3.....	A M.....	SE.....	NE.....	S by SE.....	.....	.....	.....	.....	.....	.....	.....
3.....	P M.....	E.....	NE.....	up	.....	.....	.....	.....	.....	.....	.....
7.....	A M.....	Destr.....	Destr.....	Destr.....	.....	ESE.....	S by SW.....	.....	SW.....	.....	.....
7.....	P M.....	.....	.....	.....	.....	ESE.....	S by SW.....	.....	SW.....	.....	.....
8.....	A M.....	.....	.....	.....	.....	ESE.....	S by SE.....	.....	ESE.....	.....	.....
8.....	P M.....	.....	.....	.....	.....	SE.....	S by SW.....	.....	SE.....	.....	.....
9.....	A M.....	.....	.....	.....	.....	E by SE.....	S by SE.....	.....	ESE.....	.....	.....
9.....	P M.....	.....	.....	.....	.....	E by SE.....	S.....	.....	ESE.....	.....	.....
10.....	A M.....	.....	.....	.....	up NNE.....	.....	.....	.....	ESE.....	up SE.....	.....
10.....	P M.....	.....	.....	.....	up NE.....	.....	.....	.....	up W.....	up N.....	.....
11.....	A M.....	.....	.....	.....	up W.....	.....	.....	.....	up	up ESE.....	.....
11.....	P M.....	.....	.....	.....	W.....	.....	.....	.....	up	up N.....	.....
12.....	A M.....	.....	.....	.....	NNW.....	.....	.....	.....	up S.....	up	SSW.....
13.....	A M.....	.....	.....	.....	W.....	.....	.....	.....	SW.....	up E.....	Destr.....
13.....	P M.....	.....	.....	.....	NW.....	.....	.....	.....	WSW.....	up	.....
14.....	A M.....	.....	.....	.....	up NW.....	.....	.....	.....	up W.....	up	.....
15.....	A M.....	.....	.....	.....	up	.....	.....	.....	up	up	.....
15.....	P M.....	.....	.....	.....	up	.....	.....	.....	up	up	.....
16.....	A M.....	.....	.....	.....	up	.....	.....	.....	up	up	.....
16.....	P M.....	.....	.....	.....	up W.....	.....	.....	.....	up S.....	up	.....
17.....	A M.....	.....	.....	.....	up	.....	.....	.....	up S.....	up	.....
17.....	P M.....	.....	.....	.....	up NW.....	.....	.....	.....	up	up	.....

No. 2—Concluded :

Sept.	Time.	11	11 <sup>2</sup>	13	14	15	16	17	18
2.....	A M.....	.....	.....	.....	.....	.....	.....	.....	.....
2.....	M.....	.....	.....	.....	.....	.....	.....	.....	.....
2.....	P M.....	.....	.....	.....	.....	.....	.....	.....	.....
3.....	A M.....	.....	.....	.....	.....	.....	.....	.....	.....
3.....	P M.....	.....	.....	.....	.....	.....	.....	.....	.....
7.....	A M.....	SE.....	.....	SSE.....	.....	NE.....	ENE.....	up W by SW.....	.....
7.....	P M.....	up SE.....	.....	up SE.....	up SSE.....	NNE.....	up N.....	up NW.....	.....
8.....	A M.....	SE.....	.....	SE.....	up SW.....	NE.....	up E.....	up NW.....	.....
8.....	P M.....	SE.....	.....	SE.....	up SE.....	NE.....	NE.....	.....	.....
9.....	A M.....	SE.....	.....	ESE.....	up SW.....	NE.....	NE.....	WNW.....	.....
9.....	P M.....	SE.....	.....	ESE.....	up SW.....	NE.....	NE.....	NNW.....	E.....
10.....	A M.....	SE.....	.....	ESE.....	up SW.....	NE.....	up E by NE.....	up NW.....	ESE.....
10.....	P M.....	up S.....	.....	ESE.....	up SSW.....	NE.....	NE.....	.....	ENE.....
11.....	A M.....	.....	up	.....	up SW.....	.....	.....	.....	ESE.....
11.....	P M.....	.....	up SW.....	.....	.....	.....	.....	.....	ENE.....
12.....	A M.....	.....	up	.....	.....	.....	.....	.....	ESE.....
13.....	A M.....	.....	up SW.....	.....	.....	.....	.....	.....	ESE.....
13.....	P M.....	up	.....	.....	.....	.....	.....	.....	ESE.....
14.....	A M.....	.....	up	.....	.....	.....	.....	.....	.....
15.....	A M.....	.....	up	.....	.....	.....	.....	.....	.....
15.....	P M.....	.....	up	.....	.....	.....	.....	.....	.....

No. 3.—Twenty-six inches high; poplar tree three and one-half rods east.

September.	Time.	Upper.
3.....	A M.....	N
3.....	P M.....	NW

No. 4.—Four feet and two inches high; poplar tree one rod east.

Sept.	Time.	Upper.	2	3
3.....	A M....	N by NW	NW	
3.....	P M....	NW	NW	
7.....	A M....	SW	W	S
7.....	P M....	WSW	SW	S
8.....	A M....	SW	W by SW	S
8.....	P M....	SW	W by SW	SW
9.....	A M....	SW	WSW	SSW
9.....	P M....		WSW	SW
10.....	A M....			SSW
10.....	P M....			SSW

No. 5.—Thirty inches high; poplar tree two-thirds of a rod east.

Sept.	Time.	Upper.	2
3.....	A M.....	W by NW	
3.....	P M.....	NW	
7.....	A M....	WSW	WSW
7.....	P M....	WSW	SW
8.....	A M....	WSW	WSW
8.....	P M....	W	W by SW
9.....	A M....	W	W
9.....	P M....	W	W
10.....	A M....		W
10.....	P M....		W

No. 6.—Twenty-five inches high; poplar tree one-half rod east.

Sept.	Time.	Upper.
3.....	A M.....	SE
3.....	P M.....	S
7.....	A M.....	SW
7.....	P M.....	WSW
8.....	A M.....	SW
8.....	P M.....	SW
9.....	A M.....	SW
9.....	P M.....	SW

No. 7.—Four feet high: inclining strongly toward northwest; poplar trees one rod east.

Sept.	Time.	Upper.	2	3	4
3.....	A M.....	NW	N	NW	
3.....	P M.....	WNW	WNW	WNW	
7.....	A M.....			W	WSW
7.....	P M.....			W	SW
8.....	A M.....			W	W by SW
8.....	P M.....				WSW
9.....	A N.....				WSW
9.....	P M.....				WSW
10.....	A M.....				W
10.....	P M.....				

No. 8.—Three feet and four inches high; in pasture field, isolated.

Sept.	Time.	Upper.	2	3	4
3.....	A M.....	N	N	N	S
3.....	P M.....	N	NW	NNW	S
7.....	A M.....	Destr.	Destr.	Destr.	Destr.

No. 9.—Four and one-half feet high; in pasture field, isolated.

Sept.	Time	Upper.	2	3	32	33	4	42	43	5	52
3 ....	A M	NE by N	SW	S			NE				
3 ....	P M	E	NW	S			NE				
7.....	A M....	NE	NW	SSW	SE	S	ENE	E by SE up E		SW	
7.....	P M....		NW	SSW	SSE	SW	NE			SW	
8.....	A M....		WNW	SSW	SE	SSW	ENE	E by SE ENE		SW	
8.....	P M....		WNW	SSW	SE	SW	NE		NNW	SW	
9.....	A M....		NNW	SSW	ESE	SSW	NE	E		up SW	SSE
9.....	P M....				SE	SW	.....	E		SW	SE
10.....	A M....				ESE	SSW	.....	ENE		up NNE	ESE
10.....	P M....				E by SE	SW	.....	NE		NW	ESE
11.....	A M....						SW	.....	NE	NNE	E
11.....	P M....						W	.....	NE	N	ESE
12.....	A M....						WSW	.....	NE	ENE	E by SE
13.....	A M....						SW	.....	E by SE	NE	ESE

No. 9—Concluded:

Sept.	Time.	5 <sup>3</sup>	6	6 <sup>2</sup>	7	7 <sup>2</sup>	8	9	10	11	12
3.....	A M										
3.....	P M										
7.....	A M		SE		NW		S by SW	E by SE	SSW	SSE	
7.....	P M		SE		N NW		SSW	E by SE	SW	SE	
8.....	A M		SE		N NW		S by SW	E by SE	SSW	SE	
8.....	P M		SE		NW		SSW	E by SE	WSW	SSE	E
9.....	A M		SE		NW		SSW	E by SE	SW	SE	E
9.....	P M		SE by S		NW	up	SSW	E by SE	WSW	SSE	E
10.....	A M	up	SSE	ESE	NW	up SE	SW	E	W by SW	SSE	E
10.....	P M	up W	NE	NE	up S					SSE	E
11.....	A M	up NE	E		SE						E
11.....	P M	up W	E by SE	E by NE							E
12.....	A M	up	E		ENE						E
13.....	A M	up WNW	E		SSW						E
13.....	P M	S									

No. 10.—In pasture field, isolated.

September.		Time.	Upper.	2	3	4	5
3.....	A M		N by NW				
3.....	P M		N				
7.....	A M		Destr.	ESE	ESE		
7.....	P M			SE	ESE	NNW	
8.....	A M			SE	ESE	NE	
8.....	P M			SE	ESE	NNE	
9.....	A M			SE	ESE	NE	
9.....	P M			ESE	N by NE	SW	
10.....	A M					NE	
10.....	P M					NNE	S
11.....	A M					NNB	
11.....	P M					N	SW
12....	A M					NNE	S by SW
13....	A M					NE	S by SW
13....	P M						SW
14....	A M						SSW
14....	P M						SSW
15....	A M						SSW
15....	P M						SSW
16....	A M						SSW
16....	P M						SW
17....	A M						SW
17....	P M						

No. 11.—Four feet eight inches high; in pasture field, isolated.

Sept.	Time.	Upper.	2	3	4 <sup>2</sup>	4 <sup>3</sup>	5 <sup>2</sup>	5 <sup>3</sup>	6	7	7 <sup>2</sup>
3.....	A M	NW	SW	E					E by NE	up	
3.....	P M	NE	SW	E					NE	SW	
7.....	A M			Destr.	NE	SSW	SE		E by NE	SW	
7.....	P M				NE	S by SW	E		E by NE	SW	S
8.....	A M				NNE	N by NW	ESE		E	SW	
8.....	P M					up N	SSW		E by NE	WSW	S by SE S by SW
9.....	A M				NNE	S	SW	E	E	WSW	S
9.....	P M				NNE	SSW	SSW	SSE	E	WSW	S
10.....	A M					SSW	SSW	S by SE	E by NE		SSW
10.....	P M							up S			
11.....	A M							up S			
11.....	P M							WSW			
12....	A M							SE			
13....	P M							SSE			

No. 11—Concluded:

September.	Time.	7 <sup>3</sup>	8	10	11	12	18
3.....	A M.....						
3.....	P M.....						
7.....	A M.....		E by SE	S			W by NW
7.....	P M.....		ESE	S	E by SE		SE
8.....	A M.....		ESE	S	E		S
8.....	P M.....		ESE	S by SW	E by NE	NW	S by SW
9.....	A M.....		ESE	S by SW	E by NE	NW	S by SE
9.....	P M.....		ESE	S by SW	E by NE	NW	S
10.....	A M.....	NNW			ESE	WNW	S
10.....	P M.....	Destr.			ESE	NW	S by SW
11.....	A M.....					NW	
11.....	P M.....					NW	
12.....	A M.....					WNW	
13.....	A M.....					NW	

No. 12.—Twenty-five inches high; in pasture field, isolated.

September.	Time.	Upper.	2	3
3.....	A M.....	E by NE		
3.....	P M.....	E		
7.....	A M.....		E by SE	
7.....	P M.....		SE	
8.....	A M.....		E	
8.....	P M.....		up E	
9.....	A M.....		ENE	
9.....	P M.....		ENE	W
10.....	A M.....			up S
10.....	P M.....			SSW
11.....	A M.....			SW
11.....	P M.....			W by SW
12.....	A M.....			W by SW
12.....	P M.....			WSW
13.....	A M.....			WSW
14.....	P M.....			

No. 13.—Thirty-three inches high; poplar trees two-thirds rod east; maple grove two rods south.

September.	Time.	Upper.	2
7.....	A M.....	NW	
7.....	P M.....	NW	
8.....	A M.....	NE	
8.....	P M.....	NNE	N
9.....	A M.....	NNE	NE by N
9.....	P M.....	NNE	N by NE
10.....	A M.....	Destr.	Destr.

No. 14.—Twenty-four inches high; poplar tree two-thirds rod east; maple grove two rods south.

September.	Time.	Upper.
7.....	A M.....	NW
7.....	P M.....	WNW
8.....	A M.....	WNW
8.....	P M.....	WNW
9.....	A M.....	WNW
9.....	P M.....	WNW
10.....	A M.....	WNW
10.....	P M.....	WNW
11.....	A M.....	WNW
11.....	P M.....	WNW

No. 15.—Thirty-nine inches high; uppermost heads cut off; poplar trees two-thirds rod east maple grove two rods south.

September.	Time.	1	2	3	4	5
7.....	A M.....	E	N by NE	W	.....	.....
7.....	P M.....	up E	N by NE	W by SW	.....	.....
8.....	A M.....	E	N by NE	SSW	.....	.....
8.....	P M.....	N	NW	W by SW	.....	.....
9.....	A M.....	ENE	NNE	W by SW	E by NE	.....
9.....	P M.....	E by NE	NNE	W	ENE	SW
10.....	A M.....	Destroyed	Destroyed	Destroyed	.....	.....
10.....	P M.....	.....	.....	.....	N	NNW
11.....	A M.....	.....	.....	.....	E	N by NE
11.....	P M.....	.....	.....	.....	NNE	NW
12.....	A M.....	.....	.....	.....	.....	NE
13.....	A M.....	.....	.....	.....	.....	NW
13.....	P M.....	.....	.....	.....	NE	NW
14.....	A M.....	.....	.....	.....	up ENE	.....
14.....	P M.....	.....	.....	.....	.....	.....
15.....	A M.....	.....	.....	.....	E	.....
15.....	P M.....	.....	.....	.....	E	.....

No. 16.—Three and one-half feet high; uppermost heads cut off; poplar trees two-thirds rod east; maple grove two rods south.

Sept.	Time.	2	2 <sup>2</sup>	3 <sup>2</sup>	3 <sup>3</sup>	5	5 <sup>2</sup>	5 <sup>3</sup>	6	6 <sup>2</sup>	6 <sup>3</sup>
7.....	A M.....	SSE	.....	SSW	E	ESE	.....	.....	SW	.....	.....
7.....	P M.....	SE by E	.....	SW by S	SE	SE by E	.....	.....	WSW	.....	.....
S.....	A M.....	ESE	.....	SSW	SE	SE	.....	.....	SW	.....	.....
8.....	P M.....	ESE	N	SSW	ESE	SE	ENE	.....	SW by W	.....	.....
9.....	A M.....	ESE	E	SSW	ESE	SE	E	ESE	SW	.....	.....
9.....	P M.....	ESE	NE	SSW	ESE	SE	E	ESE	SSE	.....	.....
10.....	A M.....	.....	up NW	.....	ESE	.....	up ENE	up E	.....	up NNE	.....
10.....	P M.....	.....	NNW	.....	.....	.....	ENE	SW	.....	SSE	.....
11.....	A M.....	.....	NE	.....	.....	.....	E	ESE	.....	SE	SW
11.....	P M.....	.....	N	.....	.....	.....	NE	SSE	.....	SSE	WSW
12.....	A M.....	.....	NNE	.....	.....	.....	.....	SE	.....	SE	WSW
13.....	A M.....	.....	N by NE	.....	.....	.....	.....	.....	.....	Destr.	Destr.

No. 16—Concluded:

Sept.	Time.	7	7 <sup>2</sup>	8	10	11	12	13	14
7.....	A M.....	E	.....	S by SE	E	S	NNE	E by SE	.....
7.....	P M.....	ENE	.....	S by SE	E	SW	N	E by SE	W by SW
8.....	A M.....	E by NE	.....	SSW	E	S by SW	N	.....	W by SW
8.....	P M.....	NE	.....	S	E	SW	N by NW	SSE	W
9.....	A M.....	ENE	.....	SSE	E by SE	SSW	NNE	SE	SW by W
9.....	P M.....	ENE	NW	SSE	E	SW	NNW	SE	W by SW
10.....	A M.....	.....	up SW	.....	.....	SW	NNW	SE	WSW
10.....	P M.....	.....	up NW	.....	.....	SW	N	SE	W
11.....	A M.....	.....	NW	.....	.....	S	NE	.....	SW
11.....	P M.....	.....	NW	.....	.....	W	NNW	.....	W
12.....	A M.....	.....	up	.....	.....	W	.....	N	W by SW
13.....	A M.....	.....	Destr.	.....	.....	W	NNW	.....	WSW

No. 17.—Thirty-four inches high; south of corn-field.

September.	Time.	Upper.	2
7.....	A M.....	NE	
7.....	P M.....	NE	
8.....	M A.....	ENE	
8.....	P M.....	NE	
9.....	A M.....	NE	ENE
9.....	P M.....		ENE
10.....	A M.....		NE
10.....	P M.....		NNE
11.....	A M.....		NNE
11.....	P M.....		N by NE
12.....	A M.....		N by NE
13.....	A M.....		NNE

No. 18.—Thirty-two inches high; south of corn-field.

September.	Time.	Upper.	2
7.....	A M.....		up E
7.....	P M.....		ENE
8.....	A M.....		E by SE
8.....	P M.....		NE
9.....	A M.....		E by NE
9.....	P M.....		ENE
10.....	A M.....		ENE
10.....	P M.....		NNE
11.....	A M.....		NE
11.....	P M.....		N
12.....	A M.....		N by NE
13.....	A M.....		SE

No. 19.—Five feet and eight inches high; east side of corn-field; close to plum thicket; inclined westward; uppermost head mature.

September.	Time.	2	3	3 <sup>2</sup>	4	4 <sup>2</sup>	4 <sup>3</sup>	5	5 <sup>2</sup>
7.....	A M.....	SW	ENE	S by SE	W	W	SSW	SE	S by SE
7.....	P M.....	SW	ESE	S	W	WSW	SSW	SE	SE
8.....	A M.....		ESE	S	W	W	SSW	SE	SE
8.....	P M.....		ESE	S by SW	W	W	SSW	SE	SE
9.....	A M.....		ESE	S by SW	W	W	SSW	SE	SE
9.....	P M.....		ESE	S by SW	W by NW	W by NW	SSW	SE	SE
10.....	A M.....								SE
10.....	P M.....								SE
11.....	A M.....								
11.....	P M.....								
12.....	A M.....								
13.....	A M.....								
13.....	P M.....								

No. 19—Continued:

Sept.	Time.	5 <sup>3</sup>	6	6 <sup>2</sup>	7	7 <sup>2</sup>	8	8 <sup>2</sup>	9
7.....	A M.....	NNW	SW	WSW	SW	SE	S		W by SW
7.....	P M.....	NNW	SSW	WSW	SW	SE	S		W by SW
8.....	A M.....	NNW	SW	WSW	SSW	SE	S by SE		W by SW
8.....	P M.....	SSW	NNW	W	W	SE by E	S by SE		W by SW
9.....	A M.....	S	NNW	WNW	W	SSW		SSE	W by SW
9.....	P M.....	SW		NW	W	SW		SSE	W
10.....	A M.....	up S	up NW		ESE		up ESE		
10.....	P M.....	SW			ESE		E by SE		
11.....	A M.....	SE			ESE		ENE		
11.....	P M.....	NNE			ESE		NNE		
12.....	A M.....	NE			NE		NE		
13.....	A M.....	SSE			SE		SE		
13.....	P M.....	Destr.							

**No. 19—Concluded:**

No. 20.—Three feet and nine inches high; east of corn-field; close to plum thicket.

September.	Time.	Upper.	2	3
7.....	A M.....	ESE.....	W.....	
7.....	P M.....	ESE.....	ESE.....	
8.....	A M.....	ESE.....	up S.....	
8.....	P M.....	ESE.....	up NE.....	E by NE.....
9.....	A M.....	E.....	up SE.....	ESE.....
9.....	P M.....	E.....	up.....	E.....
10.....	A M.....	E.....	up E.....	E by SE.....
10.....	P M.....	E.....	up.....	E by NE.....
11.....	A M.....	E.....	N.....	NNNE.....
11.....	P M.....	E.....	up.....	ENE.....
12.....	A M.....	E.....	up N.....	ENE.....
13.....	A M.....	E.....	SSW.....	

No. 21.—Four feet and seven inches high; south of corn-field.

No. 22.—Three feet and six inches high; south of corn-field.

September.	Time.	2	3	4
7.....	A M.....	up E	SSW	.....
7.....	P M.....	up ENE	SW	.....
8.....	A M.....	ENE	S by SW	.....
8.....	P M.....	ENE	SW	.....
9.....	A M.....	ENE	up SW	up E
10.....	A M.....	.....	.....	up ENE
10.....	P M.....	.....	.....	E
11.....	A M.....	.....	.....	ENE
11.....	P M.....	.....	.....	E
12.....	A M.....	.....	.....	E
13.....	P M.....	.....	.....	ENE
14.....	A M.....	.....	.....	up ENE
14.....	P M.....	.....	.....	up E by SE
15.....	A M.....	.....	.....	up ENE
15.....	P M.....	.....	.....	ESE
16.....	A M.....	.....	.....	ESE

No. 23.—Six feet and five inches high; south of corn-field.

No. 23—Continued:

**No. 23—Continued:**

Sept.	Time.	12	12 <sup>2</sup>	13	14	14 <sup>2</sup>	15	16	17
7.....	A M.....	SSW	SSE	NW	SE	.....	W by NW	ESE	S by SE
7.....	P M.....	SW	S	NW	SSE	.....	WNW	E	S
8.....	P M.....	SW	S	WNW	ESE	.....	WNW	E by NE	S
9.....	A M.....	SW	S by SE	NNW	ESE	.....	WNW	E by NE	S
9.....	P M.....	.....	S by SW	.....	SE	.....	WNW	E by NE	.....
10.....	A M.....	.....	S by SW	.....	SE	.....	WNW	E by NE	.....
10.....	P M.....	.....	SW	.....	SE	.....	WNW	E by NE	.....
11.....	A M.....	.....	SSW	.....	SE	.....	WNW	E by NE	.....
11.....	P M.....	.....	SW	.....	SE	.....	WNW	E by NE	.....
12.....	A M.....	.....	.....	.....	SE	.....	WNW	E by NE	.....
13.....	A M.....	.....	.....	.....	ESE	.....	WNW	E by NE	.....
13.....	P M.....	.....	.....	.....	ESE	.....	WNW	E by NE	.....
14.....	A M.....	.....	.....	.....	SE by E	.....	WNW	E by NE	.....
14.....	P M.....	.....	.....	.....	SE	.....	WNW	E by NE	.....
15.....	A M.....	.....	.....	.....	SE	.....	WNW	E by NE	.....
15.....	P M.....	.....	.....	.....	SE	.....	WNW	E by NE	.....
16.....	A M.....	.....	.....	.....	SE	.....	WNW	E by NE	.....
16.....	P M.....	.....	.....	.....	SE	.....	WNW	E by NE	.....

No. 23—Concluded:

No. 24.—Five feet and seven inches high; in corn-field; uppermost head mature.

Sept.	Time.	2	3	4	4 <sup>2</sup>	4 <sup>3</sup>	5	5 <sup>2</sup>	5 <sup>3</sup>
7.....	A M.....	SW	SE	SW	SW	SW	SW	.....	.....
7.....	P M.....	SW	SSE	WSW	SW	SE	SSW	.....	.....
8.....	A M.....	SW	SSE	W by SW	S by SW	SW	SW	.....	.....
8.....	P M.....	SW	SSE	W	SW	WSW	SW	up SW	.....
9.....	A M.....	SW	SE	W	up SW	WSW	SW	up SE	up SE
9.....	P M.....	.....	SE	SSW	WSW	WSW	SW	up SW	SE
10....	A M.....	.....	.....	SSW	WSW	.....	.....	up E	ESE
10....	P M.....	.....	.....	.....	.....	.....	.....	up NE	SE
11....	A M.....	.....	.....	.....	.....	.....	.....	.....	N E
11....	P M.....	.....	.....	.....	.....	.....	.....	.....	ESE
12....	A M.....	.....	.....	.....	.....	.....	.....	.....	N
13....	A M.....	.....	.....	.....	.....	.....	.....	.....	ESE
13....	P M.....	.....	.....	.....	.....	.....	.....	.....	SSE
14....	A M.....	.....	.....	.....	.....	.....	.....	.....	SE
14....	P M.....	.....	.....	.....	.....	.....	.....	up NE	N
15....	A M.....	.....	.....	.....	.....	.....	.....	up E	up SW
5.....	P M.....	.....	.....	.....	.....	.....	.....	.....	SW
								.....	SE

## No. 24—Continued:

Sept.	Time.	6	6 <sup>2</sup>	7	7 <sup>2</sup>	8	8 <sup>2</sup>	9	9 <sup>2</sup>
7.....	A M....	SE	up W	WSW	.....	S	.....	SSE	.....
7.....	P M....	SE	up W by NW	WSW	.....	S	.....	E by SE	.....
8.....	A M....	SE	SE	SW	.....	S by SE	.....	E by SE	.....
8.....	P M....	ESE	NNE	W by SW	.....	S by SW	.....	E by SE	.....
9.....	A M....	E by SE	ENE	W	up E	S by SE	.....	E by NE	.....
9.....	P M....	E by SE	ENE	W	.SW	S by ESW	.....	ENE	.....
10.....	A M....	.....	ENE	.....	ESE	.....	ESE	.....	up
10.....	P M....	.....	.....	E by SE	.....	SE	.....	SE	NNE
11.....	A M....	.....	.....	.....	SE	.....	ESE	.....	NE
11.....	P M....	.....	.....	.....	E	.....	S	.....	N
12.....	A M....	.....	.....	.....	NE	.....	SSE	.....	NNE
13.....	A M....	.....	.....	.....	SE	.....	S by SE	.....	SE
13.....	P M....	.....	.....	.....	N	.....	S by SE	.....	NE
14.....	A M....	.....	.....	.....	up NNE	.....	SSE	.....	NNE
14.....	P M....	.....	.....	.....	up E by SE	.....	ESE	.....	up
15.....	A M....	.....	.....	.....	.....	.....	SE	.....	up N
15.....	P M....	.....	.....	.....	.....	.....	SE	.....	up E
16.....	A M....	.....	.....	.....	.....	.....	SSE	.....	up

## No. 24—Concluded:

Sept.	Time.	10	11	12	13	14	15	17	20
7.....	A M....	S	.....	SSW	.....	N	.....	.....	W by SW
7.....	P M....	SW by W	ESE	S by SW	.....	S	.....	.....	NE
8.....	A M....	SW	SE	ESE	.....	SE	up SSW	E by SE	.....
8.....	P M....	WSW	SE	WSW	.....	.....	NNE	NNE	NE
9.....	A M....	W	SE	E by NE	.....	E by NE	NNE	NE	NE
9.....	P M....	WNW	SE	E by NE	E	NNW	NE	N	Destr.
10.....	A M....	WNW	SE	E by NE	E by SE	N by NW	NE	NE	.....
10.....	P M....	.....	.....	.....	.....	ENE	NE	N	.....
11.....	A M....	.....	.....	.....	E	.....	NNE	NE	.....
11.....	P M....	.....	.....	.....	E	.....	NE	N	.....
12.....	A M....	.....	.....	.....	E by NE	.....	S by SE	.....	.....
13.....	A M....	.....	.....	.....	E by SE	.....	.....	.....	.....
13.....	P M....	.....	.....	.....	E by SE	.....	.....	.....	.....
14.....	A M....	.....	.....	.....	E by SE	.....	.....	.....	.....
14.....	P M....	.....	.....	.....	E by SE	.....	.....	.....	.....
15.....	A M....	.....	.....	.....	E by SE	.....	.....	.....	.....

## No. 25.—Three feet nine inches high; in corn-field.

September.	Time.	Upper.	2	3	4	5	6	7
7.....	A M....	E	S by SW	E by NE	NNW	.....	.....	.....
7.....	P M....	ENE	S by SW	ENE	NNW	.....	.....	.....
8.....	A M....	E by SE	SE	ENE	ESE	ESE	E by NE	.....
8.....	P M....	E by SE	S	SE	NW	S	NNE	.....
9.....	A M....	E	SE	E by SE	NE	SE	ENE	.....
9.....	P M....	.....	SSE	ESE	up N	S by SW	ENE	.....
10.....	A M....	.....	.....	ESE	NE	ESE	ENE	.....
10.....	P M....	.....	.....	.....	ESE	ESE	NE	.....
11.....	A M....	.....	.....	.....	NNE	SE	NNE	.....
11.....	P M....	.....	.....	.....	N	SE	NE	.....
12.....	A M....	.....	.....	.....	.....	SE	NE	.....
13.....	A M....	.....	.....	.....	.....	SSE	ENE	.....
13.....	P M....	.....	.....	.....	.....	SSE	ENE	.....
14.....	A M....	.....	.....	.....	.....	ESE	NE	up W
14.....	P M....	.....	.....	.....	.....	.....	.....	N
15.....	A M....	.....	.....	.....	.....	.....	.....	N by NE
15.....	P M....	.....	.....	.....	.....	.....	.....	NW
16.....	A M....	.....	.....	.....	.....	.....	.....	up WNW
16.....	P M....	.....	.....	.....	.....	.....	.....	WNW
17.....	A M....	.....	.....	.....	.....	.....	.....	WNW

No. 26.—Two feet high; poplar trees two-thirds of a rod east; maple grove two rods south.

September.	Time.	Upper.
8.....	A M.....	NE
8.....	P M.....	NNW
9.....	A M.....	N by NE
9.....	P M.....	N by NW
10.....	A M.....	NNW
10.....	P M.....	NW
11.....	A M.....	N by NW
11.....	P M.....	NW
12.....	A M.....	WNW
13.....	A M.....	WNW

No. 27.—Sixteen inches high; on north side of and very close (six inches) to a large poplar tree.

September.	Time.	Upper.
8.....	A M.....	NE
8.....	P M.....	NW
9.....	A M.....	N by NW
9.....	P M.....	NW
10.....	A M.....	NW
10.....	P M.....	NW
11.....	A M.....	NW

No. 28.—Three feet high; isolated, in pasture field.

September.	Time.	Upper.	2	3	4	5
8.....	A M.....	ESE				
8.....	P M.....	SE	up SW			
9.....	A M.....	E by SE	up SE	E		
9.....	P M.....	E by SE	up SW	E by NE		
10.....	A M.....	E by SE	up S by SW	E		
10.....	P M.....	NE	SW	up NE		
11.....	A M.....	E	ESE	NE		
11.....	P M.....		SE	NNE	up S	
12.....	A M.....		ESE	NW	up SW	up SW
13.....	A M.....			W	SSW	SSW
13.....	P M.....		ENE	Destr.	Destr.	S

No. 29.—Three feet and three inches high; isolated, in pasture field.

Sept.	Time.	Upper.	2	3	3 <sup>2</sup>	4	5	6	7	8
8.....	A M	ESE								
8.....	P M	SW								
9.....	A M	ESE	up	ESE						
9.....	P M	E by SE	W by NW	ESE						
10.....	A M	E by SE	up E	SE by S	up N					
10.....	P M	Destr.		SE	up W	ESE				
11.....	A M			SE		Destr.	WSW			
11.....	P M			SE						
12.....	A M			ESE			ESE	SE	up	SE
13.....	A M			SE			E by SE	SW	SE	
13.....	P M						Destr.	NW	SE	
14.....	A M							E	WNW	SE
14.....	P M							E	WNW	SE
15.....	A M				up			ENE	NW	ESE
15.....	P M				up			E by NE	NW	SE by E
16.....	A M							E by NE	NW	ESE
16.....	P M				up E by NE				NW	

No. 30.—Thirty-two inches high; isolated, in pasture field.

Sept.	Time.	Upper.	2	3	4	5	6
8.....	A M.....	E.....	.....	.....	.....	.....	.....
8.....	P M.....	NE.....	.....	.....	.....	.....	.....
9.....	A M.....	ESE.....	.....	.....	.....	.....	.....
9.....	P M.....	E by SE.....	SW.....	SE.....	.....	.....	.....
10.....	P M.....	E by SE.....	SSE.....	SE.....	.....	.....	.....
10.....	A M.....	NE.....	WSW.....	SE.....	.....	.....	.....
11.....	A M.....	E by NE.....	SE.....	E by SE.....	.....	.....	.....
11.....	P M.....	NE.....	SW.....	ESE.....	NNW.....	.....	.....
12.....	A M.....	ENE.....	SSE.....	ESE.....	NE.....	.....	.....
13.....	A M.....	SSE.....	S.....	S.....	NW.....	.....	.....
13.....	P M.....	.....	WSW.....	SE.....	NW.....	.....	.....
14.....	A M.....	.....	WSW.....	SE.....	NNW.....	WSW.....	ENE.....
14.....	P M.....	.....	WSW.....	SE.....	NNW.....	WSW.....	E by NE.....
15.....	A M.....	.....	WSW.....	ESE.....	NW.....	WSW.....	E.....
15.....	P M.....	.....	SW.....	ESE.....	NNW.....	SW.....	E.....
16.....	A M.....	.....	SW.....	SE by E.....	NW.....	SW.....	E by SE.....
16.....	P M.....	.....	SE.....	SE.....	NW.....	WSW.....	ESE.....
17.....	A M.....	.....	SE.....	SE.....	NW.....	WSW.....	E by SE.....
17.....	P M.....	.....	SE.....	SE.....	NNW.....	W.....	E.....

No. 31.—Eleven feet high; south of corn-field; uppermost four heads mature and therefore not counted.

Sept.	Time.	4 <sup>2</sup>	5 <sup>3</sup>	6 <sup>2</sup>	6 <sup>3</sup>	7 <sup>2</sup>	7 <sup>3</sup>	8 <sup>3</sup>	8 <sup>4</sup>	8 <sup>5</sup>	9 <sup>2</sup>
8.....	A M.....	S.....	.....	S.....	SW.....	WSW.....	SW.....	ESE.....	S.....	ESE.....	SE.....
8.....	P M.....	SSE.....	up WSW.....	up SSE.....	WSW.....	SW.....	ESE.....	S.....	SE.....	SE.....	E.....
9.....	A M.....	SE.....	up SE.....	SE.....	SE.....	WSW.....	up SE.....	ESE.....	SE.....	ESE.....	E.....
9.....	P M.....	SSE.....	up SW.....	SE.....	SW.....	W.....	up SW.....	ESE.....	SSE.....	SE.....	E.....
10.....	A M.....	ESE.....	up W.....	SW.....	.....	.....	up W.....	.....	SSE.....	SE.....	.....
10.....	P M.....	ESE.....	WNW.....	WSW.....	.....	.....	NW.....	.....	up S.....	SE.....	.....
11.....	A M.....	.....	.....	.....	.....	.....	N.....	.....	S.....	SE.....	.....
11.....	P M.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12.....	A M.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
13.....	A M.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
13.....	P M.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14.....	A M.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14.....	P M.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
15.....	A M.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
15.....	P M.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

No. 31—Continued:

Sept.	Time.	9 <sup>3</sup>	10 <sup>3</sup>	10 <sup>4</sup>	11 <sup>4</sup>	11 <sup>5</sup>	11 <sup>6</sup>	11 <sup>7</sup>	12 <sup>2</sup>	12 <sup>3</sup>	13 <sup>3</sup>
8.....	A M.....	SE.....	WSW.....	.....	S.....	SE.....	up S.....	SE.....	SSW.....	up SW.....	S by SW.....
8.....	P M.....	ENE.....	W by SW.....	.....	S.....	SE.....	SE.....	ESE.....	S by SW.....	W.....	S by SW.....
9.....	A M.....	ENE.....	W by SW.....	.....	SE.....	ESE.....	SE.....	ESE.....	SE.....	up NW.....	S by SW.....
9.....	P M.....	ENE.....	W.....	.....	SW.....	ESE.....	SE.....	ESE.....	SW.....	NW.....	SSW.....
10.....	A M.....	NE.....	.....	.....	up E.....	ESE.....	SE.....	E.....	ENE.....	up SW.....	NW.....
10.....	P M.....	.....	.....	.....	N.....	.....	NE.....	NE.....	up SW.....	up SW.....	SW.....
11.....	A M.....	.....	.....	.....	.....	NE.....	.....	NE.....	NE.....	.....	.....
11.....	P M.....	.....	.....	.....	.....	NNW.....	.....	NNW.....	NNW.....	.....	.....
12.....	A M.....	.....	.....	.....	.....	N.....	.....	NE.....	NNE.....	.....	.....
13.....	A M.....	.....	.....	.....	.....	SSW.....	.....	ESE.....	ESE.....	.....	.....
14.....	A M.....	.....	.....	.....	.....	NW.....	.....	.....	.....	.....	.....
14.....	P M.....	.....	.....	W by NW.....	.....	W.....	.....	.....	.....	.....	.....
15.....	A M.....	.....	.....	.....	.....	W.....	.....	.....	.....	.....	.....

**No. 31—Continued:**

Sept.	Time.	13 <sup>4</sup>	14 <sup>2</sup>	14 <sup>3</sup>	15 <sup>2</sup>	15 <sup>3</sup>	15 <sup>4</sup>	16 <sup>4</sup>	16 <sup>5</sup>	16 <sup>6</sup>	17
8.....	A M	S	SW	NNE	S	SSE	.....	ENE	SSE	SSE	N by NE
8.....	P M	S by SE	E by NE	NNW	S by SW	S	.....	ENE	SE	SE	N N
9.....	A M	ESE	E by NE	NNE	S	E	.....	ENE	SE	SE	N
9.....	P M	S	E by NE	N	SW	up SW	.....	ENE	SE	SE	.....
10....	A M	up NE	.....	.....	SW	up N	.....	.....	.....	SE	.....
10....	P M	NW	.....	.....	.....	.....	.....	.....	.....	ESE	.....
11....	A M	N	.....	.....	.....	.....	ESE	.....	.....	.....	.....
11....	P M	NNW	.....	.....	.....	.....	NE	.....	.....	.....	.....
12....	A M	N	.....	.....	.....	.....	SE	.....	.....	.....	.....
13....	A M	SSE	.....	.....	.....	.....	SE	.....	.....	.....	.....
13....	P M	.....	.....	.....	.....	up N	.....	.....	.....	.....	.....
14....	A M	.....	.....	.....	.....	.....	NW	.....	.....	.....	.....
14....	P M	.....	.....	.....	.....	.....	SE	.....	.....	.....	.....
15....	A M	.....	.....	.....	.....	.....	ESE	.....	.....	.....	.....
15....	P M	.....	.....	.....	.....	.....	SE	.....	.....	.....	.....
16....	A M	.....	.....	.....	.....	.....	SE	.....	.....	.....	.....
16....	P M	.....	.....	.....	.....	.....	S by SE	.....	.....	.....	.....
17....	A M	.....	.....	.....	.....	.....	ESE	.....	.....	.....	.....
17....	P M	.....	.....	.....	.....	.....	ESE	.....	.....	.....	.....

**No. 31—Continued:**

Sept.	Time.	18 <sup>2</sup>	18 <sup>3</sup>	18 <sup>4</sup>	19 <sup>2</sup>	19 <sup>3</sup>	20 <sup>2</sup>	20 <sup>3</sup>	20 <sup>4</sup>	21 <sup>3</sup>	21 <sup>4</sup>
8.....	A M	E by NE	SE	SE	.....	SE	ESE	.....	.....	SE	SE by SE
8.....	P M	E by SE	SE	SE	.....	N	S by SE	.....	.....	SE	SE by SE
9.....	A M	E by SE	SE	ESE	.....	ESE	SSE	.....	.....	ESE	ESE by ESE
9.....	P M	.....	.....	ESE	ESE	.....	SSE	.....	.....	ESE	ESE by ESE
10.....	A M	.....	.....	ENE	up NE	NE	.....	up E	.....	.....	.....
10.....	P M	.....	.....	NNW	NNE	NNE	.....	N	.....	.....	.....
11.....	A M	.....	.....	.....	NNE	.....	.....	NE	.....	.....	.....
11.....	P M	.....	.....	.....	NNW	.....	.....	N	.....	.....	.....
12.....	A M	.....	.....	.....	N	.....	.....	N by NE	.....	.....	.....
13.....	A M	.....	.....	.....	SE	.....	.....	SE	.....	SW	.....
14.....	A M	.....	.....	.....	.....	.....	.....	up NE	.....	SW	.....
14.....	P M	.....	.....	.....	N	.....	.....	up NE	.....	SW	.....
15.....	A M	.....	.....	.....	.....	.....	.....	NE	.....	SW	.....
15.....	P M	.....	.....	.....	.....	.....	.....	up NE	.....	SW	.....
16.....	A M	.....	.....	.....	.....	.....	.....	.....	.....	SW	.....
16.....	P M	.....	.....	.....	.....	.....	.....	W by SW	.....	.....	.....
17.....	A M	.....	.....	.....	.....	.....	.....	W by SW	.....	.....	.....

No. 31—Concluded:

No. 32.—Five feet three inches high; thick grove one-half rod west; south of corn-field.

September.	Time.	Upper.	2	3	3 <sup>a</sup>	4	5	6
9.....	A M.....	NE	E by S	E	.....	ENE	E	E by NE
9.....	P M.....	NE	E	E	.....	NE	E	E
10.....	A M.....	NNE	ENE	E	.....	NE	.....	E by NE
10.....	P M.....	NNE	ENE	E by NE	.....	ENE	NE	E by NE
11.....	A M.....	.....	.....	.....	.....	.....	.....	E by NE
11.....	P M.....	.....	.....	.....	.....	.....	.....	NE
12.....	A M.....	.....	.....	.....	.....	.....	.....	E by NE
13.....	A M.....	.....	.....	.....	.....	.....	.....	E
13.....	P M.....	.....	.....	.....	E by SE	.....	.....	.....
14.....	A M.....	.....	.....	.....	ESE	.....	.....	.....
14.....	P M.....	.....	.....	.....	SE by E	.....	.....	.....
15.....	A M.....	.....	.....	.....	SE	.....	.....	.....
15.....	P M.....	.....	.....	.....	SE	.....	.....	.....
16.....	A M.....	.....	.....	.....	SE	.....	.....	.....
16.....	P M.....	.....	.....	.....	ENE	.....	.....	.....
17.....	A M.....	.....	.....	.....	ENE	.....	.....	.....
17.....	P M.....	.....	.....	.....	NE	.....	.....	.....

No. 32—Concluded:

September.	Time.	7	8	9	10	11	12	13
9 .....	A M.....	NE	ESE	ENE	E by NE	NE	SE	.....
9 .....	P M.....	NE	E	NE	ENE	NNE	S	.....
10.....	A M.....	N by NE	E	NNE	ENE	NE	SE	.....
10.....	P M.....	N by NE	E by NE	NNE	NE	S	NE	.....
11.....	A M.....	NE	E by NE	NNE	.....	S	NE	.....
11.....	P M.....	N	ENE	NNE	.....	up N	N	N
12.....	A M.....	N	.....	NE	.....	N by NE	ESE	NNE
13.....	A M.....	.....	.....	E	.....	NE	ESE	ENE
13.....	P M.....	.....	.....	.....	.....	.....	.....	.....

No. 33.—Three feet eight inches high; south of corn-field; grove one-half rod west.

September.	Time.	Upper.	2	3	4	5
9.....	A M.....	NE	E by SE	E	NE	ESE
9.....	P M.....	NE	ENE	E by SE	NE	SE
10.....	A M.....	NE	ENE	E by SE	NE	ESE
10.....	P M.....	.....	up	E by SE	NE	ESE
11.....	A M.....	.....	.....	.....	ENE	E
11.....	P M.....	.....	.....	.....	N by NE	N by NE
12.....	A M.....	.....	.....	.....	NE	N by NE
13.....	A M.....	.....	.....	.....	NE	E

No. 34.—Thirty-four inches high; south of corn-field; grove one-half rod west.

September.	Time.	Upper.	2
9.....	A M.....	SW	
9.....	P M.....	ESE	
10.....	A M.....	ESE	up E
11.....	A M.....	.....	NE
11.....	P M.....	.....	N
12.....	A M.....	.....	N by NE
13.....	A M.....	.....	E by SE
13.....	P M.....	.....	ENE
14.....	A M.....	.....	ENE
14.....	P M.....	.....	E by NE
15.....	A M.....	.....	E
15.....	P M.....	.....	E by NE
16.....	A M.....	.....	E
16.....	P M.....	.....	NE
17.....	A M.....	.....	NE

No. 35.—Twenty-four inches high; south of corn-field; grove one-half rod west.

September.	Time.	Upper.
9.....	A M.....	E
9.....	P M.....	ENE
11.....	A M.....	NE
11.....	P M.....	N
12.....	A M.....	NE
13.....	A M.....	E

No. 36.—Three feet five inches high; six feet east of peach thicket; west of corn-field.

Sept.	Time.	Upper.	2	3	4	5	6
9.....	A M.....	NE	ESE	E	ENE	.....	.....
9.....	P M.....	NNE	ESE	E	NE	.....	.....
10.....	A M.....	.....	ESE	.....	NE	Up E by NE	E
10.....	P M.....	.....	.....	.....	NNE	ESE	E
11.....	A M.....	.....	.....	.....	NE	ESE	E
11.....	P M.....	.....	.....	.....	N	NE	ENE
12.....	A M.....	.....	.....	.....	NE	E	E
13.....	A M.....	.....	.....	.....	NE	ESE	E
13.....	P M.....	.....	.....	.....	.....	E by NE	E by NE
14.....	A M.....	.....	.....	.....	.....	E by NE	E by NE
14.....	P M.....	.....	.....	.....	.....	E by NE	E
15.....	A M.....	.....	.....	.....	.....	.....	E
15.....	P M.....	.....	.....	.....	.....	.....	E

No. 37.—Thirty-two and one-half inches high; west of corn-field; six feet east of peach thicket.

September.	Time.	Upper.	September.	Time.	Upper.
9.....	A M.....	SE	11.....	A M.....	SE
9.....	P M.....	E by NE	11.....	P M.....	ESE
10.....	A M.....	ESE	12.....	A M.....	ESE
10.....	P M.....	ESE	13.....	A M.....	ESE
			13.....	P M.....	

No. 38.—Three and a half feet high; peach thicket six feet westward.

September.	Time.	Upper.	2	3	4
9.....	A M.....	ENE	ESE	E	.....
9.....	P M.....	NE	SW	E	.....
10.....	A M.....	.....	SE	E by NE	up N
10.....	P M.....	.....	SE	E by NE	WNW
11.....	A M.....	.....	ESE	E	NNE
11.....	P M.....	.....	E	ENE	NNW
12.....	A M.....	.....	E	E	N
13.....	A M.....	.....	.....	NE	N by NE
14.....	A M.....	.....	.....	E	NNE
14.....	P M.....	.....	.....	E	NE
15.....	A M.....	.....	.....	.....	NE
15.....	P M.....	.....	.....	.....	NE
16.....	A M.....	.....	.....	.....	NE
16.....	P M.....	.....	.....	.....	NNE
17.....	A M.....	.....	.....	.....	NNE
17.....	P M.....	.....	.....	.....	.....

No. 39.—Five feet high; isolated; inclined southward; heads one to four dead.

September.	Time.	5	6	7	8
9.....	A M.....	SE	SE	E by SE	ESE
9.....	P M.....	S	SE	up	SE
10.....	A M.....	SW	SE	up SW	up N
10.....	P M.....	SSW	ESE	up NW	up S
11.....	A M.....	.....	.....	NE	NE
11.....	P M.....	.....	.....	NNW	SSE
12.....	A M.....	.....	.....	N	ESE
13.....	A M.....	.....	.....	up	S
13.....	P M.....	.....	.....	.....	.....

No. 40.—Four and a half feet high; north of corn-field by wire fence.

Sept.	Time.	Upper.	2	3	4	5	6	7	8	9	10	11
9.....	A M	E by NE	NE	ESE	E by SE	.....	.....	EN	NE	ESE	E by SE	.....
9.....	P M	NNE	N	SE	E by SE	up W	SE	EN	NE	ESE	ESE	ESE
10.....	A M	.....	N	SE	NE	up SE	SE	.....	NE	ESE	up S	ESE
10.....	P M	NNW	ESE	NE	.....	up SW	SE	.....	ESE	up SW	ESE	.....
11.....	A M	.....	.....	.....	NE	SE	ESE	.....	ESE	up S	ESE	E
11.....	P M	.....	.....	.....	.....	up NW	ESE	.....	NE	SW	.....	.....
12.....	A M	.....	.....	.....	.....	NE	E by SE	.....	E	SW	.....	.....
13.....	A M	.....	.....	.....	.....	up SE	ESE	.....	E	SE	.....	.....
13.....	P M	.....	.....	.....	.....	up N	up E	.....	.....	S	.....	.....
14.....	A M	.....	.....	.....	.....	up ENE	up ESE	.....	.....	up SE	.....	.....
14.....	P M	.....	.....	.....	.....	up S	SE	.....	.....	SSE	.....	.....
15.....	A M	.....	.....	.....	.....	S by SE	SE	.....	.....	SSE	.....	.....
15.....	P M	.....	.....	.....	.....	SE	SE	.....	.....	S by SE	.....	.....
16.....	A M	.....	.....	.....	.....	SE	SE	.....	.....	SSE	.....	.....
16.....	P M	.....	.....	.....	.....	.....	.....	.....	.....	SW	.....	.....
17.....	A M	.....	.....	.....	.....	.....	.....	.....	.....	E by SE	.....	.....
17.....	P M	.....	.....	.....	.....	.....	.....	.....	.....	up W	.....	.....

## NOTES AS TO DIRECTION OF WIND.

Sept. 2. Wind (not strong) from the southeast.

Sept. 3. Wind light, and as on the preceding day.

Sept. 7. Strong wind (and rain) during the preceding night.

Sept. 8. Very light breeze from the north.

Sept. 9. No wind in the morning; very light breeze from the east during the day.

Sept. 10. Cloudy, and very light breeze from the east in the morning; cloudy and a very light breeze from the south and southeast in the evening.

Sept. 11. Cloudy and foggy, and a moderate wind from the south in the morning; clear, and the wind moderately strong from the south and south-southeast in the evening.

Sept. 12. Cloudy, and a slight breeze from the south in the morning; a very strong wind from the north in the evening, and hence no observation recorded.

Sept. 13. Heavy frost; in the evening wind from south-southeast.

Sept. 14. Slight breeze from the south in the morning, which continued through the day.

Sept. 15. No wind.

Sept. 16. Strong breeze from the east in the morning; no breeze in the evening.

Sept. 17. Gentle breeze from the south.

#### NOTES ON SORGHUM SMUTS.

BY W. A. KELLERMAN AND W. T. SWINGLE.

Sorghum is now an important fodder and sugar plant of our State, and one that is generally supposed to be comparatively free from the attacks of vegetable parasites. It is therefore a matter of interest to record the fact that two species of smut have been found this year at Manhattan—one not previously noticed here nor hitherto reported as occurring in the United States—(*Ustilago Reiliiana*.) It will undoubtedly cause serious loss if it becomes prevalent over the State. It attacks not only sorghum, but Indian corn, and even sugar cane also. The other species (*Ustilago Sorghi*), confined to sorghum, is more abundant and likewise a destructive species. The following brief accounts are given of the two species:

I. *UTSILAGO SORGHI* (Link.?) Passerini, in Thüm. Herb. myc. oec. n. 63. (?*Sporisorium Sorghi* Link. Sp. Pl. II, p. 86.)

This species, which has been reported from Washington, D. C.,<sup>1</sup> Madison, Wis.,<sup>1</sup> New York,<sup>1</sup> and Lincoln, Neb.,<sup>2</sup> on sorghum grown from imported seed, was found by Mr. H. M. Cottrell on the College Farm, Manhattan, Kas., in small quantities, on sorghum raised from seed received from the U. S. Department of Agriculture. The seed had been obtained through the U. S. Consul at Calcutta. It was found later by Prof. G. H. Failyer, on sorghum grown by the Chemical Department on a different part of the College Farm, from seed received from Dr. Peter Collier. The seed in this case had been imported from Africa and not previously grown in this country. One variety grown by the Chemical Department that was attacked, was received under the name of *Huansa Byn*, and the others (designated by numbers) were *Rangoon* varieties. Many of these were badly attacked, and in some cases as many as one-fourth the heads were smutted. The smutted varieties grown by the Farm Department were very unlike the preceding. Of these there were three numbers quite similar in appearance, and they may have been one and the same variety.

Mr. A. A. Denton, of the Sterling Syrup Works, Sterling, Kansas, has recently sent us a specimen of this smut. He says that in some lots about half of the seed heads were affected. Several varieties of sorghum (*vulgare*?) were attacked, but all were grown from foreign seed.

This species, unlike the following, attacks only the individual grains, or seeds, in the panicle. They become abnormally large and elongated, and completely filled with the mass of spores.

(1) William Trelease, Preliminary List of the Parasitic Fungi of Wisconsin, p. 34.

(2) H. J. Webber, Rusts and Smuts of Nebraska, Bulletin of the Agr. Exp. Sta. Nebr., No. 11, p. 69; also Catalogue of the Flora of Nebraska in Report of the Botanist, p. 74, Extr. from Report Nebr. State Bd. Agr. for 1889.